



Comparing success and engagement in gamified learning experiences via Kahoot and Quizizz

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ABSTRACT

The purpose of the present study was to investigate the reflections of gamification activities that are used as a formative assessment tool based on academic achievement and student engagement in learning environments. It was also aimed to investigate whether the utilization of the gamification tool led to a difference in academic achievement and student engagement. Three research groups were determined; two experimental groups where 7E instructional model gamified with Kahoot and Quizizz was implemented and a control group where conventional 7E instruction method was implemented. The groups were determined by random assignment of 97 pre-service teachers who took scientific research methods course in the 2017–2018 academic year spring semester. However, since only 71 of the assigned pre-service teachers voluntarily participated in the study, the study data included 71 pre-service teachers. At the beginning and the end of the six-week-long instruction activities, the academic achievement test and student engagement scale on the content instructed in the six-week-long scientific research methods course were applied. Furthermore, in-depth views of pre-service teachers were obtained with focus group interviews. Therefore, the study was conducted with mixed design principles. The study findings demonstrated that the scientific research methods academic achievement \times student engagement \times group interaction model (*Wilks's lambda* = .819, $F_{[2, 66]} = 7.301$, $p < 0.05$) was significant. The activities gamified with Kahoot application, albeit statistically insignificant, had a more positive impact on academic achievement and student engagement when compared to the other groups. On the other hand, it was observed that the positive impact of the activities gamified with Quizizz application was lower than that of the instruction method utilized in the control group both based on academic achievement ($\Delta\bar{x}_{\text{pretest-posttestquizizz}} = 38.116$, $\Delta\bar{x}_{\text{pretest-posttestcontrol}} = 38.776$) and student engagement ($\Delta\bar{x}_{\text{pretest-posttestquizizz}} = 12.176$, $\Delta\bar{x}_{\text{pretest-posttestcontrol}} = 14.218$). Opposed to quantitative findings, pre-service teachers expressed views about the problems they experienced under the sub themes of motivation, reinforcement, entertainment, competition sub-themes in gamification activities and stated that they were generally positive about the activities and experienced problems related to the infrastructure and the tool.

1. Introduction

While the digital revolution rapidly changes the world, it also changes the humankind. The modern children, who were born to digital technologies and called Millennials or the Y-Generation, are raised in a world where everyone has a computer in their pockets

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(Koivisto & Hamari, 2014). These modern children both learn differently (Prensky, 2014) and prefer to learn the information that is useful, fun and relevant (Jukes & Dosaj, 2004). The requirement to know how this generation can learn better and what their preferred learning styles are (Arabaci & Polat, 2013) has emerged as a new educational problem (Campbell, 2016). The education industry faced new challenges and had to be redesigned based on the needs, preferences and orientations of digital natives in order to be successful in the 21st century (Prensky, 2001). The approach that instructional activities designed based on student needs increased the success in education (Demirtaş & Kahveci, 2010) introduced the need for new methods.

The lack of student motivation to learn (Lee & Hammer, 2011) and the lack of student engagement in the instructional environment (Kumar & Khurana, 2012) became a fundamental problem in modern education as a result of the digital revolution (Kiryakova, Angelova, & Yordanova, 2014). It was reported in several studies in the literature that this problem cannot be resolved by conventional methods and the motivation and engagement in learning cannot be achieved (Barata, Gama, Jorge, & Gonçalves, 2015; Bell, 2014; Buckley & Doyle, 2016; Erhel & Jamet, 2013; Hamari & Koivisto, 2014; Jui-Mei, Chun-Ming, Hwang, & Yueh-Chiao, 2011; Kapp, 2012; Muntean, 2011; Zichermann & Cunningham, 2011) and it was suggested that “gamification,” which could be effective on the improvement of learners’ motivation and engagement, should be introduced to the education system as a new approach.

Marczewski (2012) reported that the concept of gamification was first introduced by Nick Pelling in 2002, while Gaggioli (2012) attributed the concept solely to Jesse Schell (2008). There are differences in the definition of the gamification concept, similar to the differences in the roles attributed to different individuals at its induction (Burke, 2011; Deterding, 2011; Deterding, Dixon, Khaled, & Nacke, 2011; Gökkaya, 2014; Kapp, 2012; Lee & Hammer, 2011). Gamification is used to describe a type of connection between games and anything that is not a game (Campbell, 2016). Gamification is a method used to apply game elements to non-game contexts (Deterding et al., 2011). The aim of gamification is not to create a game-like new world, but to transfer the game elements into the real world to capture similar senses without leaving the reality (Arkün-Kocadere & Samur, 2016, pp. 397–414). In education, gamification is a way of playing creative games in classroom without jeopardizing the scientific nature of a curriculum (Nolan & McBride, 2014). In an educational setting, gamification supports the individuals to acquire the potential to develop critical thinking and multi-tasking, while training successful 21st century digital natives (Kapp, 2012; Prensky, 2001). Gamification makes learning more entertaining, increasing the motivation of the students to learn and study (Muntean, 2011). Furthermore, gamification provides data on student learning by enabling more efficient, accurate and timely information for teachers, parents, administrators and public policy makers (Darling-Hammond, 2010).

Instant feedback capability using game elements such as scores, badges, rankings and rewards in gamification leads to student engagement in learning environment and enforces their behavior to reach targets (Glover, 2013), as well as providing the opportunity to monitor the learning achievements and transparent assessment of these achievements (Clariso et al., 2017, pp. 105–116; Kapp, 2012; Lee & Hammer, 2011). Feedback is a significant component of the assessment process. Formative assessment, one of the assessment methods, is focused on the active use of the feedback (Delacruz, 2011). According to Shute and Spector (2010) the use of gamification as a formative assessment tool provides in first information on the learning processes of the individuals. It also allows us to observe the motivation of individuals, to monitor their emotional and metacognitive traits, and to understand their specific behavior. Third, instant feedback based on embedded or confidential evaluations allows individuals to be aware of the difficulties that they experience in games (Shute & Spector, 2010). Also, the use of gamification as an assessment tool demonstrates the strengths and weaknesses of the game design. Delacruz (2011) examined the impact of game feedback in different detail levels on students’ mathematics performances. In the present experimental study, three scoring methods (detailed, minimal, without scoring information) were used. It was concluded that mathematics performances of the students increased as the level of detail in gamification increased. Rapti (2013, pp. 255–262) demonstrated that gamification could be successful as an alternative method of student assessment.

Literature review demonstrated that there were only a few studies where the gamification was used for assessment purposes (Arkün-Kocadere & Çağlar, 2015; Attali & Arieli-Attali, 2015; Delacruz, 2011; Dichev & Dicheva, 2017; Ismail & Mohammad, 2017; Oliver, 2017; Rapti, 2013, pp. 255–262; Turan & Meral, 2018). There are gaps in the literature on the impact of the gamification on assessment. In particular, determination of the differences between conventional assessment and assessment with gamification would contribute to this gap in the literature (Jackson & McNamara, 2013). In the present study, the course was designed with the 7E instructional model based on the constructivist approach. The design was based on the 7E steps proposed by Eisenkraft (2003). Eisenkraft (2003), in contrast to Bybee (2003), argued that the prior knowledge of the students should be tested in the engagement step. In the present study, gamification was used as a formative assessment tool in the engagement step where the prior knowledge of the students is tested and in the evaluation step where whether the students learned the content is tested. Three groups were designed and three groups were instructed with the constructivist 7E instruction approach in the scientific research methods course. However, gamification was used in the stages of engagement and evaluation in the experiment group, while only the question-answer method was used in the control group. The present study aimed to determine the impact of formative assessment conducted with conventional method and gamification tools on the success and engagement of pre-service teachers.

There are several free applications that could be used for formative assessment: Edmodo (LMS, exams, surveys, and indicators); Socrative (exams, surveys, gamification, indicators); Kahoot (quizzes gamification, surveys and indicators); Quizizz (quizzes and words, cultural games, etc.); Google Forms and Flubaroo (exams and indicators); Padlet; Mentimeter; Edpuzzle (video quiz could be integrated into Edmodo). Review of the previous studies in the literature (Biçen & Kocakoyun, 2018; Borrell, Cosmas, Grymes, & Radunzel, 2017; Ismail & Mohammad, 2017; Licorish, George, Owen, & Daniel, 2017; Licorish, Owen, Daniel, & George, 2018; Medina & Hurtado, 2017; Solmaz & Çetin, 2017; Tsihouridis, Vavougiou, & Ioannidis, 2017; Yapıcı & Karakoyun, 2017) demonstrated that Kahoot application was used more frequently in gamification activities when compared to the other applications. Kahoot is a globally accepted online learning platform based on behavioral approach with more than 30 million users (Plump & LaRosa, 2017).

Table 1
Comparison of Kahoot and Quizizz applications based on instructional quizzes.

Comparison Criteria	Kahoot	Quizizz
Presentation of the questions	Questions are asked to the whole group using a projector or computer screen, where only the answer options are reflected on the participant screens.	Both the questions and answer options are presented individually on participant screens in different order.
Progression	All participants answer the next question after all participants answer the previous question or when the time allowed for the question is over.	Each participant can answer the next question after she/he answers the previous question on her/his screen or the time allowed to answer that question is over.
Feedback	The statistics for the answers of a particular question is presented between the questions.	Based on the correct or incorrect answer of a particular participant, positive or negative messages are presented immediately after the response.
Technical requirements	Application requires a large screen where all participants could read the questions, a projection device, smartboard, an Internet connected device such as a smartphone, tablet, laptop or computer that the participants could use to answer the questions.	An Internet connected device such as a smartphone, tablet, laptop or computer where the instructor could initiate the quiz and participants could answer the questions.
The length of questions	Each question could include maximum 95 characters, each answer option could include maximum 60.	There is no character limitation.
Development of questions and choices	4 multiple choice answers. Visuals could be included in the questions. No preview when developing the questions.	The number of multiple choice answers is flexible. Both questions and answer options could include visuals. Preview is available when developing the questions.

Quizizz is also a similar Web 2.0 tool, which is popular in the field of assessment. Quizizz has advantages and disadvantages when compared to Kahoot. Comparison of the features of these two applications based on assessment demonstrated that there were differences in the presentation of questions, feedbacks, progression speed and method of the questions, technical requirements, etc. These differences are summarized in [Table 1](#).

As demonstrated in [Table 1](#), there are certain differences between the Kahoot and Quizizz applications, which were frequently used in previous gamification studies. Both applications have both advantages and disadvantages. Each new gamification activities has to transform the disadvantages of another gamified activities into advantages. It is necessary to determine the better gamified design that would be used as a formative assessment tool. In the present study, two different experiment groups and a control group were determined and Kahoot application was used in one experimental group and Quizizz application was used in the other experimental group. The aim of the present study was to determine the strengths and weaknesses of these gamification experiences via two different tools.

The question “What are the effects of gamification used as a formative assessment tool to academic achievement and student engagement” forms the basis of the research.

The sub-questions investigated within the framework of the basic question of the study are as follows:

1. Does gamification as a formative assessment tool affect academic achievement?
 - a. What is the impact of activities gamified with Kahoot application on academic achievement?
 - b. What is the impact of activities gamified with Quizizz application on academic achievement?
2. Does gamification as a formative assessment tool affect student engagement?
 - a. What is the impact of activities gamified with Kahoot application on student engagement?
 - b. What is the impact of activities gamified with Quizizz application on student engagement?
3. What are the professional and personal views of pre-service teachers on gamification applications?
 - a. What are the views and recommendations of pre-service teachers who participated in activities gamified with Kahoot application on the application?
 - b. What are the views and recommendations of pre-service teachers who participated in activities gamified with Quizizz application on the application?

2. Methodology

The study was designed with mixed method principles. Mixed method is defined as the integration of qualitative and quantitative approaches, data collection tool and data analysis in order to obtain in depth research data or validate the collected data ([Johnson, Onwuegbuzie, & Turner, 2007](#), p. 123). Furthermore, in mixed method research, both qualitative and quantitative research questions are investigated ([Creswell & Plano Clark, 2007](#), p.5). The first and second research questions were investigated with the quantitative research approach and the third research question was investigated with the qualitative research approach. Thus, it can be observed that a research consistent with the nature of mixed methodology was conducted.

In the study, mixed methodology convergent parallel design was implemented. Convergent parallel pattern is a mixed-method design where both the quantitative and qualitative research steps and data are collected and analyzed separately with equal priority and without correlation ([Dede & Demir, 2014](#); Trans., p.79). Quantitative study data were collected with an experimental process. In the experimental process, data were collected via an academic achievement test and student engagement scale. In the experimental

Table 2

Distribution of the participants based on the groups and data collection tools.

Study Group	Planned	Participation in the academic achievement test	Participation in the student engagement scale	Participation in focus group interviews
Kahoot experiment	30	20	20	6
Quizizz experiment	33	26	25	6
Control	34	25	24	–
Total	97	71	69	12

process, qualitative data were collected with focus group interviews conducted with pre-service teachers who experienced instruction activities gamified with Kahoot and Quizizz applications to obtain their in-depth views. More specifically, quantitative and qualitative data were collected in processes that did not interfere with each other in the study. The study data were analyzed separately and associated by responding to the research questions. In short, the study was conducted with the convergent parallel design within the framework of mixed methodology.

2.1. Participants

The study participants included 97 pre-service teachers who took scientific research methods (SRM) course in Adıyaman University, Faculty of Education during the 2017–2018 academic year. Based on the study purposes, two experimental groups were determined since it was considered that the differences mentioned in Table 1 could alter the efficiency and productivity of gamification activities. In the first group, Kahoot, and in the second, Quizizz activities were conducted. A control group was organized in order to determine whether the changes were a result of the presentation of the course content or the gamification application. Thus, instruction activities were conducted with three groups: two experiment groups and one control group. In the experimental process, simple random sampling technique was used to determine the group members. The participants were randomly divided into three branches in the study. Group A (Kahoot experiment group) included 30, Group B (Quizizz experiment group) included 33, Group C (control group) included 34 participants. However, since the pre-tests were conducted before the presentation of the content and the participation in the research process was volunteer-based, and the data collected from the participants who did not participate in either the pre-test or the post-test could not be analyzed, the number of participating pre-service teachers changed. These changes are presented in Table 2.

As seen in Table 2, the analyzed participant data varied between the groups. In addition to the previously explained reasons related to the data collection process, certain students who took the course in the previous year, but failed the course, and did not have to attend the course on the second year due to requirements of the Turkish higher education system were not able to participate in the study. The number of participants in the study decreased due to the above-mentioned factors, however it was considered that the differentiation between the number of participants in different groups was not significant.

The pre-service teachers that participated in the focus group interviews were determined with the maximum diversity sampling technique. The maximum diversity sampling, a non-probabilistic sampling method, entails selection of individuals that could provide answers relevant for the purpose of the study and who are experienced in the research questions in a way to reflect diversity with respect to the significant study variable or variables (Balci, 2011, p. 103; McMillan, 2004, p.114). It was generally advised that groups that included between six and eight participants were the optimum size for focus group interviews (Bloor, Frankland, Thomas, & Robson, 2001, p. 26). Thus, six pre-service teachers were selected for focus group interviews. Attention was paid to ensure that the pre-service teachers that participated in focus group interviews attended the activities regularly, were highly, moderately and less successful pre-service teachers. Since six consecutive volunteer pre-service teachers participated in the focus group interviews, it was considered that both the voluntary basis required by the qualitative research approaches and the requirement of maximum diversity in participants based on a criterion by quantitative approach were met in the present study.

2.2. Data collection tools and process

Data were collected using three processes and tools. An academic achievement test, developed to compare academic achievement on the content of the initial six weeks of the SRM course, and a student engagement scale developed by Günüş and Kuzu (2015) to investigate the impact of the course instructed with the 7E method on the engagement of pre-service teachers were utilized. In the final stage, data were collected with focus group interviews that were conducted to determine the views and assessments of pre-service teachers on gamification techniques that were not scrutinized by the measurement tools.

2.2.1. Academic achievement test

The academic achievement test was based on the 24 achievements included in the first six units of the SRM course. In order to measure all achievements, a statement table and a 30-item pool, where each achievement was measured with at least one question, were developed. This form was applied to 100 pre-service teachers who previously took the SRM course. The scores obtained in the test were divided into groups of upper and lower 27 percentile. Difficulty and distinctiveness indices were calculated for the scores in the lower and upper groups. It was planned to exclude the items with a distinctiveness limit lower than 0.20 in order not to reduce the

content validity, however since the exclusion of the items with a distinctiveness score of 0.19 decreased the content validity, these items were included in the achievement test and options in these items were reorganized. Thus, 20-item achievement test with a mean difficulty of 0.58, and a distinction score between 0.19 and 0.73, where each item had 5 options was finalized. Academic achievement pre-test and post-test data for the pre-service teachers that participated in the experimental process were collected using the above-mentioned test.

2.2.2. Student engagement scale

Another data collection tool used in the study was the student engagement scale developed by [Günüş and Kuzu \(2015\)](#). The scale includes 41 items and six factors such as valuing, sense of belonging, cognitive engagement, peer relationships, relationships with faculty members and behavioral engagement. The total variance explained was 59%. Cronbach's alpha (α) internal consistency reliability coefficient for the initial scale was 0.929. Thus, it was suggested that the scale was reliable for the purposes of the present study.

2.2.3. Focus group interviews

Five questions were asked to the participants in focus group interviews, which were the data collection technique used to collect the qualitative study data. These questions included in the interviews aimed to determine the views of pre-service teachers on the positive/negative effects of the tools used in gamification activities with respect to learning, peer interaction, learner-teacher interaction, and problems encountered during implementation and solutions of these problems and provided feedback. The following questions were included in the interviews after the opinion of the two field experts were obtained:

1. In your opinion, what are the positive effects of Kahoot/Quizizz applications with respect to
 - a. Your learning
 - b. Social interactions, etc.
2. What were the problems you experienced in Kahoot/Quizizz applications?
 - a. What could be the reasons for these problems?
 - b. What are your recommendations for the solution of these problems?
3. What are your views on the impact of the feedback provided during the Kahoot/Quizizz applications?
4. Would you like to participate in another Kahoot/Quizizz application? Why?

The above-mentioned data collection tools were used to obtain data for different purposes of the study. Quantitative study data were collected during a six-week period. The instructional activities were conducted at the same time at the same classroom and by the same instructor on different days. Thus, an attempt was made to ensure that the probable differences between the experimental groups were not affected by external variables. During the 2017–2018 academic year spring semester, after information was provided for the pre-service teachers about the research process, the academic achievement test developed by the researchers and the student engagement scale developed by [Günüş and Kuzu \(2015\)](#) were applied. This was immediately followed by the instruction of the course with the 7E model. During the five-week course, instructional activities were conducted using 7E method that included engage and evaluation activities gamified with Kahoot in the first experiment group and with Quizizz in the second experimental group. In the control group, instructional activities were conducted with 7E method that did not include gamification activities. After the five-week instruction process conducted with the above-mentioned methods, the academic achievement test and student engagement scale were reapplied to the three groups. The collected data constituted the pre-test and post-test of the quantitative dimension of the study.

Immediately after the completion of the instruction activities, focus group interviews were conducted with the first and second experimental groups in separate sessions. The focus group interviews were conducted in the researcher's office during the hours determined by the researcher and pre-service teachers. Focus group interviews aimed to reveal the views of the pre-service teachers on the advantages and disadvantages of the utilized tools (Kahoot and Quizizz), the problems experienced during the process and solution recommendations, and their satisfaction or dissatisfaction about the process. After the written and verbal consent of the pre-service teachers were obtained, focus group interviews were conducted on a suitable date and time for the group. The focus group interviews with the experimental group where Kahoot-based instructional activities were conducted lasted for 17 min and 1 s and the focus group interviews with the experimental group where Quizizz-based instructional activities were conducted lasted for 24 min and 38 s and both interviews were recorded on tape.

In the frame of mix method principles, data were collected via mentioned tools throughout experimental process. Experimental process was designed as had three different groups, two of them was experiment group and the other one was control group. All groups got student engagement scale and academic achievement test before and after the process, and the courses conducted in the frame of 7E teaching method. For experimental groups, one got quizzes at the beginning and at the end of course designed via Kahoot, the other one got it designed via Quizizz. For control group participants, they got the same questions and feedbacks at the beginning and at the end of course in verbal way. By this way, the difference between gamified and non gamified quizzes, also the difference of gamification tools, could be shown. After experimental process, to detail the difference and indicate the views of participants, focus group interviews were conducted with experimental groups. The interviews were not conducted with control groups' participants because they did not have any experience on gamification activities or tools. After collecting data, data analysis process was began.

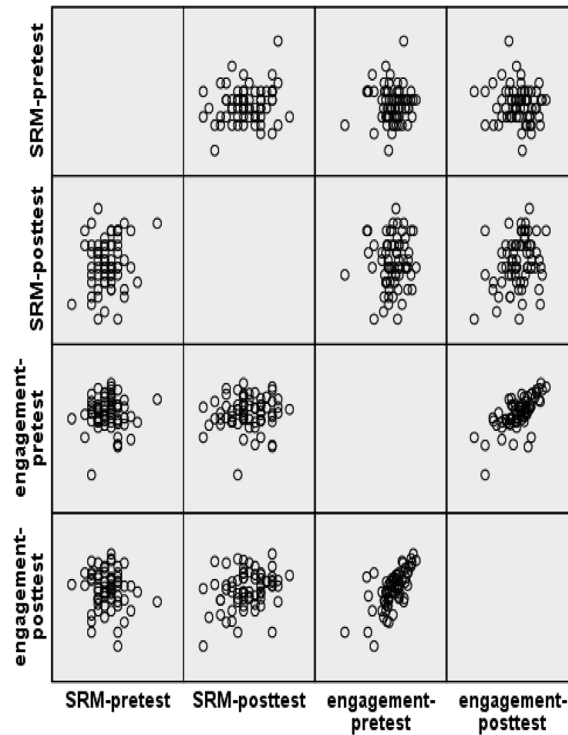


Fig. 1. Scatter graph of independent variables.

2.3. Data analysis

In the quantitative dimension of the study, the dependent variable that included two pretests and two posttests, and a three-category independent variable that included two experimental groups and a control group were compared. The data analysis process was conducted with the mixed design MANOVA, which analyzes all the above-mentioned data at once (Field, 2009, p. 822). The prerequisites for this test and the consistence of the research data with these prerequisites were as follows:

1. The study dataset was analyzed based on the cook's distance and centered leverage values and it was observed that there were no outliers. As defined in the participants section of the present study, the prerequisites of the minimum data count should be equal to the number of dependent variables in each independent variable cell and there should be at least 20 participants in the cells (Pearson, Pearson, & Hartley, 1958; Tabachnick & Fidell, 2012, p. 73; 252) were met.
2. 3. Multilinearity of the dependent variables were analyzed with scatter graph and it was observed that the variables exhibited multiple normal distribution. Scatter graph is presented in Fig. 1.
3. Homogeneity of variance-covariance matrices was tested with Box's test of equality of covariance matrices. As result, it was observed that variance and covariance matrices were equal (Box's $M = 14,45$, $F_{[20, 14403.897]} = 0,658$, $p > 0.05$) (Çokluk, Şekercioğlu, & Büyüköztürk, 2012, p. 20). Furthermore, when Levene's test of equality of error variances was examined, it was observed that the error variances of both dependent variables were equal ($F_{\text{SRM-pre}[2,66]} = 0,581$, $p > 0.05$; $F_{\text{SRM-post}[2,66]} = 0,045$, $p > 0.05$; $F_{\text{enga-pre}[2,66]} = 0,533$, $p > 0.05$; $F_{\text{enga-post}[2,66]} = 0,557$, $p > 0.05$).

As reported below, since the necessary requirements for MANOVA were met, mixed design MANOVA was conducted in the study. The data obtained with the focus group interviews, where the qualitative study data were collected, was analyzed with inductive content analysis technique. Inductive content analysis is defined as detailed and systematical analysis of a certain material in order to determine patterns, themes, judgments and meanings (Bogdan & Biklen, 2007, p. 173; Neuendorf, 2002, p. 17). In other words, a detailed study of the obtained codes is defined as inductive content analysis (Lune & Berg, 2017, p. 183). In the analysis, the audio recordings of the participants were reviewed, and the statements of the participants were replaced with codes for use in the analysis and reporting processes. For trustworthiness of study, interviews were conducted by the researcher who conducted the lessons during whole semester and by this way, According to Guba (1981), if they know the interviewer and the interviewer was naturalised during process, participants answered the questions without any suspect. Additionally, privacy of participants was guaranteed and the direct coded was written with participants' word with nicknames. Since the analysis of focus group interviews was conducted independently, the participants were assigned code names by the interviewer and K-nickname format was used for the Kahoot focus group interviewees and Q-nickname format was used for Quizizz focus group interviews, and these nicknames were not shared with anyone. For Shenton (2004) debate and confirmation of analysis and member checking were the ways of supporting trustworthiness

Table 3
MANOVA results.

Effect	F	df	η^2	Power	p
SRM academic achievement	940.17	1, 66	.934	1.000	.000
SRM academic achievement*group	0.693	2, 66	.021	.162	.504
Student engagement	247.394	1, 66	.789	1.000	.000
Student engagement*group	7.203	2, 66	.179	.924	.001
SRM academic achievement*student engagement	257.853	1, 66	.796	1.000	.000
SRM academic achievement*student engagement*group	7.301	2, 66	.181	.927	.001

the qualitative analysis. The data of this study were coded by two different researchers separately and these were unified and structured. After that the themes and subthemes with related codes were shown to the participants and asked whether they meant that or not for member checking. Since they expressed that there was no misunderstandings and mistakes, the qualitative data analysis process was finalized.

3. Findings

In this section of the study, quantitative findings and qualitative findings are presented separately. The main reason for this was the fact that the data were collected and analyzed separately due to the nature of the research design. In the conclusion section, the above-mentioned findings were integrated and discussed as a whole.

3.1. Quantitative findings

Based on the study purposes and the nature of the collected data, the quantitative study findings were obtained with mixed design MANOVA. The first and second research questions were answered using the MANOVA results. Specifically, whether gamified 7E instructional model led to a change in academic achievement and student engagement of the students in experimental groups was analyzed with this test. The analysis results are presented in Table 3.

The analysis revealed (a) a significant SRM academic achievement test interaction (*Wilks's lambda* = .066, $F_{[1, 66]} = 940.17$, $p < 0.05$); (b) a significant student engagement scale score interaction (*Wilks's lambda* = .211, $F_{[1, 66]} = 247.394$, $p < 0.05$); (c) a significant student engagement \times group interaction (*Wilks's lambda* = .821, $F_{[2, 66]} = 7.203$, $p < 0.05$); (d) a significant SRM academic achievement \times student engagement interaction (*Wilks's lambda* = .204, $F_{[1, 66]} = 257.853$, $p < 0.05$); (e) a significant SRM academic achievement \times student engagement \times group interaction (*Wilks's lambda* = .819, $F_{[2, 66]} = 7.301$, $p < 0.05$). Review of the significance levels of the analysis presented in Table 3 demonstrated that there was no statistically significant difference between SRM academic achievement and group (*Wilks's lambda* = .979, $F_{[2, 66]} = 0.693$, $p > 0.05$). When observed power for this comparison was analyzed, it could be suggested that the sample size was not sufficient since the analysis power was under 0.80 ($Power_{[SRM\ academic\ achievement*group]} = .162$) (Cohen, 1988, p. 248).

When the measurement analyzes with statistically significant differences are analyzed, it was observed that all had a greater than 0.5 power value. This indicated that the study produced valid findings that explained the scrutinized model based on power (Cohen, 1988, p. 116). However, when the effect size was reviewed, it was observed that the effect size was smaller than 0.5 in the analyzes conducted with the comparative model (Student engagement*group and SRM academic achievement*student engagement*group) based on the group variable. This was mainly due to the fact that the whole model could not be explained by the measurements and the presence of other variables that affect the model but not measured in the present study. When power and effect sizes were considered holistically, it was determined that the sufficient sample size was obtained for the conducted analysis, however the presence of other variables led to the above-mentioned variance.

Furthermore, the results of multiple comparison tests were examined to determine the source of the above-mentioned variance. Since the results of Levene's test of equality of error variances ($p > 0.05$) demonstrated that the error variances were homogeneous, the analysis was conducted with Post hoc Scheffe test. Scheffe test results are presented in Table 4.

Table 4
Scheffe test scores.

Tested Measure	(I) Group	(J) Group	$\Delta\bar{x}_{(I-J)}$	Se	p
SRM academic achievement* student engagement	kahoot	quizizz	1.977	1.6143	.476
		control	1.720	1.6292	.575
	quizizz	kahoot	-1.977	1.6143	.476
		control	-.257	1.5378	.986
	control	kahoot	-1.720	1.6292	.575
		quizizz	.257	1.5378	.986

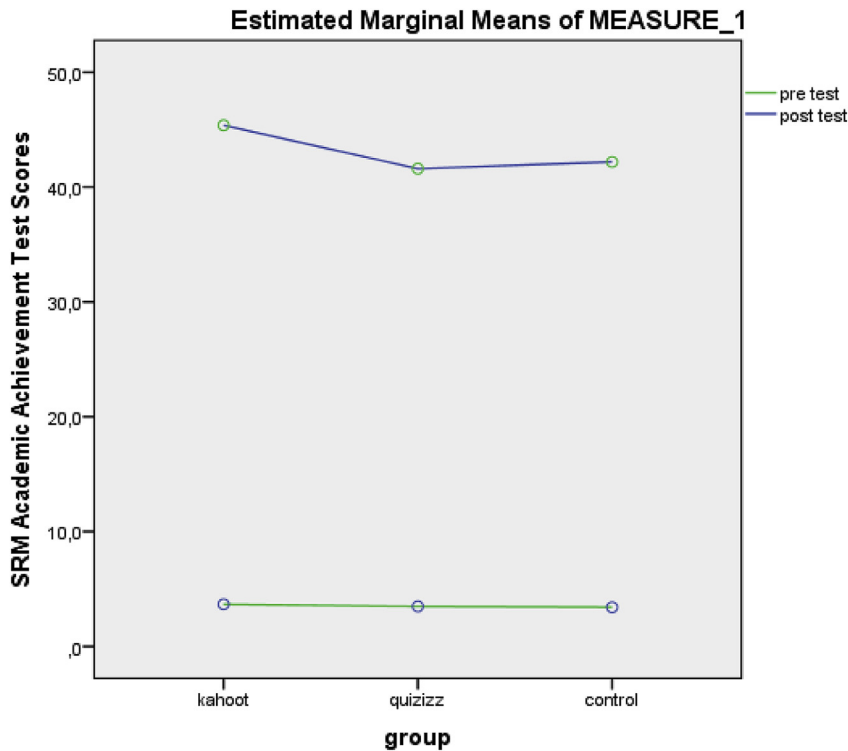


Fig. 2. Distribution of SRM academic achievement test scores by experiment groups.

Based on the Scheffe test results, it was determined that there was no variance between the measurements based on the groups. As is known, multivariate analysis simultaneously analyzes several measurements or variables and the impact of the correlation between these variables on the findings, preventing the Type I errors (Huck, 2009, p. 212). Thus, it is possible for the variables scrutinized separately in multiple comparison tests to fail to lead to a significant difference (Huck, 2009, p. 218). In other words, the variances resulting from the MANOVA test are due to inter-measurement interaction. Since analysis of the variance based on the groups eliminates the above-mentioned correlation, a variance is not observed. More clearly, the statistical difference was shown on model came from the interaction between test scores and group variance. From this point of view, to see the basis of this difference the scores should be examined separately. However, although there was no statistically significance variance between the groups, a certain level of variance was determined in academic achievement and student engagement tests. Distribution of the variance between the SRM academic achievement test pretest and posttest scores among the groups is presented in Fig. 2.

As seen in Fig. 2, there was a difference between SRM academic achievement pretest and posttest scores. However, this is expected in experimental studies. The difference between the variation between the groups should be examined in the graph. It was observed that while mean SRM academic achievement pretest scores were similar ($\bar{x}_{pretestkahoot} = 3.664$, $\bar{x}_{pretestquizizz} = 3.484$, $\bar{x}_{pretestcontrol} = 3.412$), there was a difference between the posttest scores based on the groups ($\bar{x}_{posttestkahoot} = 45.365$, $\bar{x}_{posttestquizizz} = 41.600$, $\bar{x}_{posttestcontrol} = 42.188$). The most significant difference was observed in the Kahoot experiment group ($\Delta\bar{x}_{pretest-posttestkahoot} = 41.701$). Similarly, the distribution of the variation between the groups in student engagement pretest and posttest scores was analyzed and presented in Fig. 3.

Analysis of the mean student engagement pretest score presented in Fig. 3 demonstrated that there were minor variances between the groups based on student engagement scores ($\bar{x}_{pretestkahoot} = 13.823$, $\bar{x}_{pretestquizizz} = 16.454$, $\bar{x}_{pretestcontrol} = 15.691$). Although there was an increase in posttest scores in all groups ($\bar{x}_{posttestkahoot} = 35.216$, $\bar{x}_{posttestquizizz} = 28.630$, $\bar{x}_{posttestcontrol} = 29.909$), the highest variation was observed in the Kahoot experiment group ($\Delta\bar{x}_{pretest-posttestkahoot} = 21.393$). This explained the fact that there was no variance in post hoc tests despite the variation observed in the MANOVA model. Similarly, the fact that the effect sizes were below 0.50 and the variance in the pretest results was consistent. Thus, it could be suggested that, in addition to the experimental measurements, other variables such as the variations in pre-service teachers assigned with random sampling and attitudes towards scientific research could have affected the study findings.

Holistic analysis of Figs. 2 and 3 demonstrated that the activities gamified with Kahoot application, albeit statistically insignificant, had a more positive impact on academic achievement and student engagement when compared to the other groups. On the other hand, it was observed that the positive impact of the activities gamified with Quizizz application was lower than that of the instruction method utilized in the control group both based on academic achievement ($\Delta\bar{x}_{pretest-posttestquizizz} = 38.116$, $\Delta\bar{x}_{pretest-posttestcontrol} = 38.776$) and student engagement ($\Delta\bar{x}_{pretest-posttestquizizz} = 12.176$, $\Delta\bar{x}_{pretest-posttestcontrol} = 14.218$). Thus, it could be suggested that the use of Quizizz application in gamification activities utilized in the present study did not have any positive effects on academic

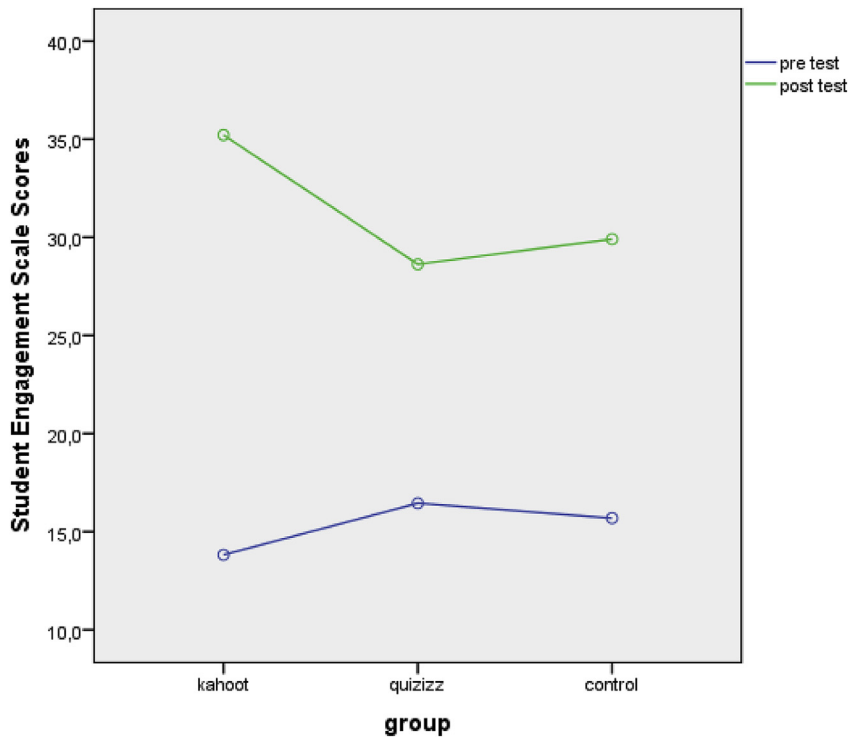


Fig. 3. Distribution of student engagement scale scores by experiment groups.

achievement and student engagement.

3.2. Qualitative findings

In this section of the study, focus group interviews that were conducted to answer the 3rd research question were analyzed. Due to the nature of the present study, the focus group interviews were conducted in two different sessions; with the group that was instructed using activities gamified with the Kahoot application, and the group that was instructed using activities gamified with the Quizizz application. Since the questions were developed for the relevant gamification tool based on the experiences of pre-service teachers, the group data were compared and analyzed independently. In this section, the findings of the focus group interviews conducted with six participants in the Kahoot experiment group and the findings of the focus group interviews conducted with six participants in the Quizizz experiment group are presented and the themes derived from the two interview group findings were compared. For protecting participants' privacy, nicknames were used with used gamification tools' first letters. Kahoot interview focus groups' participants were named as K-nickname, Quizizz interview focus groups' participants were named as Q-nickname.

3.2.1. The Kahoot focus group interviews

Focus group interviews were analyzed by two researchers that conducted the present study. According to Krueger (2006), it is better for more than one individual to analyze the data in focus group interviews. Independent analyzes were combined and the views of pre-service teachers were categorized under the themes of "reinforcement," "motivation," "competition," "entertainment," "active participation," "infrastructure problems," and "tool-based problems." In detail analysis of the codes under these themes led to the identification of the following main themes: "impact on learning," "interaction," and "problems." The above-mentioned qualitative findings are visualized in Fig. 4.

As seen in Fig. 4, focus group interviews revealed a structure that included three main themes and seven sub-themes. The pre-service teachers discussed the effects of the study tools on their learning simply in the sub-themes of reinforcement and motivation. On the topic, K-Özer stated the following: "I can state that it is a nice material for reinforcement and comprehension of the subject," while K-Eda stated the following: "I had a good grade in the exam, since I gave wrong answers to Kahoot questions, I learned the correct answers and my grade was good ... For instance, Kahoot made it possible for me to see my mistakes since I generally gave the wrong answers, we learn from our mistakes, isn't it?" And K-Sude stated "It allowed us to repeat the previous week, it was very useful in this respect, it reminded us the things we learned." Furthermore the above-mentioned views were considered under the motivation sub-theme. Participant K-Funda stated that "Thanks to Kahoot, we are able to listen to the instructions better so that we could answer the questions correctly," K-Eda: "In the first weeks, my grades were bad, but later I came to the class prepared for the quizzes that we took at the beginning of each class, I think this led to ambition," and K-Sude: "I think it is also important to use such technological tools in the course, we absolutely comprehend the course better." The views of pre-service teachers on this theme were positive. It can be suggested that integration of the technologies in the

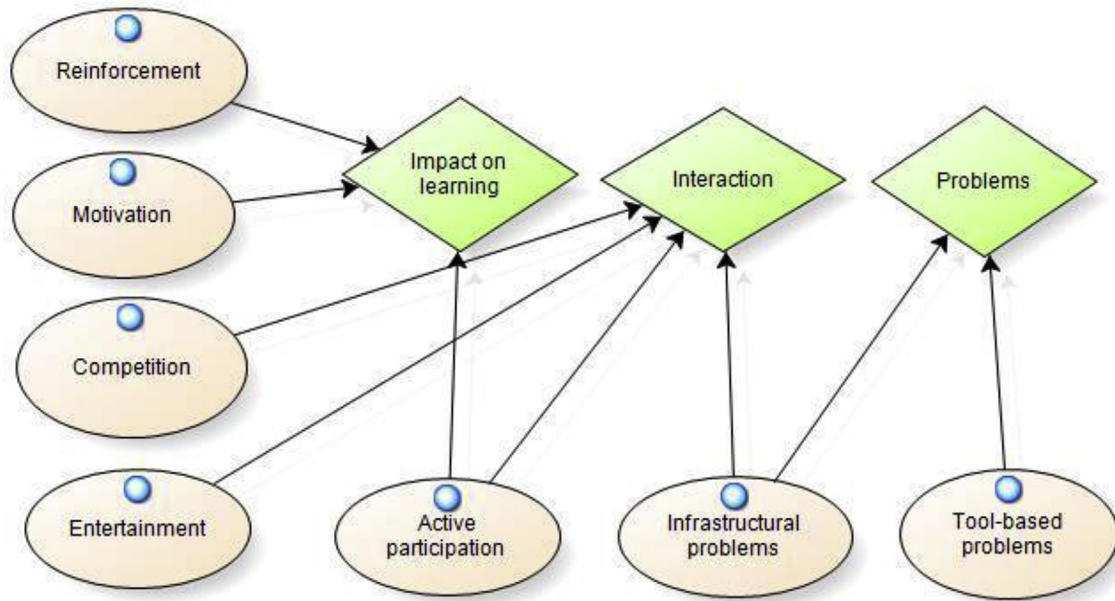


Fig. 4. Themes and sub themes obtained in Kahoot focus group interviews.

instruction process was effective as noted by the pre-service teachers.

The views of pre-service teachers that were classified under the theme of interaction were analyzed within the framework of competition, entertainment and active participation sub-themes. In the context of competition sub-theme, they mentioned positive reflections of competitive motivation in the classroom environment as stated by K-Özer: *“The fun competition among us made a positive contribution to listening and concentration on the course better.”* K-Funda stated that the course was quite entertaining and K-Sude stated that it was out of the ordinary, leading to the suggestion that it was possible to introduce entertainment, which is one of the basic elements of the gamification, to the classroom environment. K-Eda and K-Özer stated their views on the sub-theme of active participation with the using the following statements: *“The student participation is more active, and there are more interesting aspects.”* Furthermore, K-Meltem stated that *“(Previously,) you just instructed the subject and we listened, in other words, we had to participate, but you included us with the Kahoot application, we interacted with you, its applied nature was nice,”* underlying the impact of both interaction and active participation on learning. Thus, it was suggested that active participation sub-theme was correlated with both learning and interaction themes.

Similar to several research on educational technologies, a number of infrastructural problems were experienced in the present study. These problems were mentioned by K-Özer as follows in the most general sense: *“We had problems with Internet access and the school infrastructure.”* Furthermore, K-Ecem stated the following: *“Not all had Internet access, they were not able to connect to the school network, some of them had slow connection and they could not participate.”* In this statement, the pre-service teacher mentioned a situation that affected the implementation process and the participation of the pre-service teachers, not an individual impact. Thus, it was suggested that the infrastructure problems had a negative impact on interaction and this sub-theme was associated with the interaction theme. In addition to infrastructural problems, pre-service teachers reported certain Kahoot-oriented problems. Certain Kahoot-oriented problems were mentioned by K-Funda as follows: *“Questions were viewable only on the screen and this distracted me a lot, I was even searching for the question in the beginning, I lost a great amount of time.”* K-Eda stated that *“There were no options on the phone, we even marked the wrong option while looking at the screen”* and K-Meltem stated that *“We were allowed to answer the question (within) five seconds, sometimes we did not understand the questions, when we solved the questions with you, we retained more information.”* Thus, it was concluded that high hardware requirements of the Kahoot tool, and the fact that the questions and multiple choice answers were on different screens distracted the learners, and therefore problems were experienced in implementation.

3.2.2. The Quizizz focus group interviews

Quizizz focus group interview sub-themes and themes were consistent with Kahoot focus group interview sub-themes and themes. The only difference was the presence of participant data that demonstrated that the sub-themes of entertainment and competition were correlated with the impact on learning theme. The remaining correlations were the same. It was suggested that this was due to the fact that the same questions were used in both interviews, the participants experienced the same quiz questions and the same content in the experimental process, and although there were differences between the Kahoot and Quizizz tools, they were similar with respect to the fact that they are both gamification tools. The correlations between the themes and sub-themes in Quizizz focus group interviews are presented in Fig. 5.

The analysis model presented in Fig. 5 includes seven sub-themes and three main themes. The first of these themes explains the

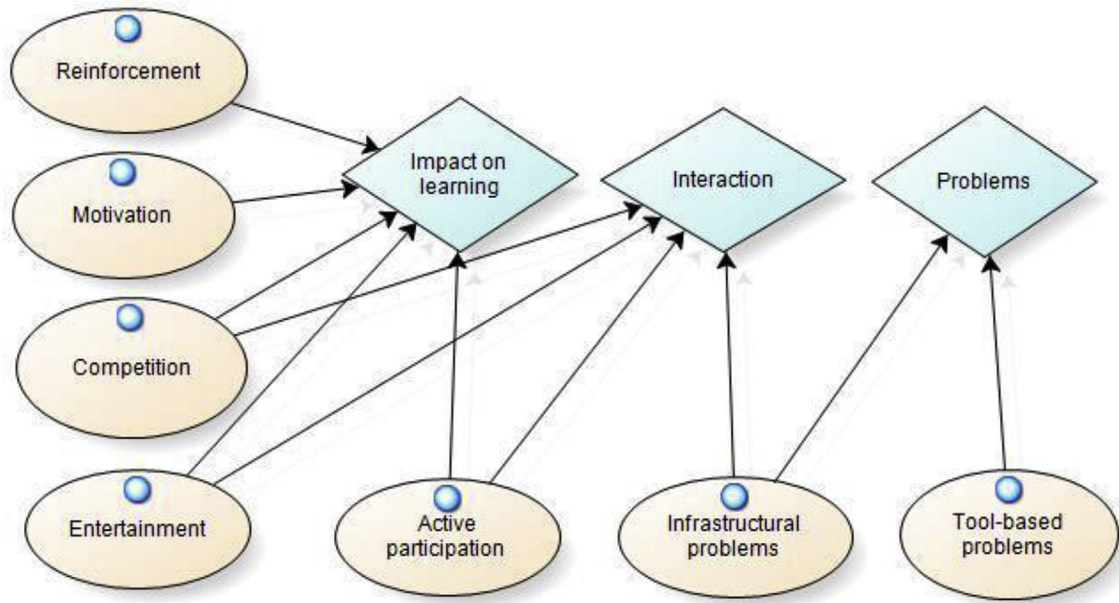


Fig. 5. Themes and sub themes in Quizizz focus group interviews.

impact of Quizizz on learning. During the interviews, the participants were engaged in the following dialogue within the framework of the reinforcement sub-theme:

“Q-Nilay: *It helped reinforce the content we learned in the course better*

Q-Faruk: *We had the opportunity to revise the topics we learned*

Q-Ozan: *We had the opportunity to correct our mistakes by learning the accurate content. We revised the questions later on as follows: when I make a mistake, I remember this better, as you explained the questions afterwards, I remembered (the content) better.”*

Based on the above-mentioned dialogue, particularly Q-Ozan's statement, it can be suggested that the implementation of Quizizz reinforced learning, however this should be supported by face-to-face feedback. Furthermore, the participants' views were positive on the sub-theme of motivation as observed in the following statements: Q-Nilay: “*Since we knew that Quizizz would be given at the end of the course, we were more focused during the instruction.*” Q-Faruk: “*Our ambition was productive, we started to learn more.*”

It was determined that the pre-service teachers interpreted the Quizizz application within the sub-themes of competition, entertainment and active participation and the dimension of interaction based on their responses. On competition sub-theme, Q-Yunus stated the following: “*The effect of the course was immediate, such as ‘you were/were not the leader,’ in a funny sense,*” and Q-Azim stated that “*Due to the time allotted, there was an entertaining competition.*” The dialogue between Q-Yunus and Q-Azim quoted below was the main reason for the correlations between competition sub-theme, interaction theme and impact on learning theme:

“*-The competitive environment was great*

-We learned about the learning levels of our friends, who learned how much.”

Furthermore, the following statement by Q-Esin also contributed to the above-mentioned conclusion: “*We reinforced our knowledge and the competitive environment was fun.*”

Although the participants expressed positive views on the theme of entertainment using statements similar to Q-Faruk (“*Seeing Trump and smileys make it fun*”), as Q-Yunus mentioned in the dialogue below, there were contradicting views about the visual feedback in Quizizz:

“Q-Yunus: *I do not think anybody cares for these feedback*

Q-Esin: *I cared, I liked them very much*

Q-Azim: *Me, too, ugly pictures appeared when we made a mistake*

Q-Yunus: *I tried to answer the next question as soon as possible, I only remember Trump*

Q-Nilay: *No, I liked these emoji-like things very much, they were nice.”*

As seen in the dialogue above, a neutral if not negative approach was observed about the feedback function of the tool. Participant Q-Esin established an association between entertainment and learning with the following statement: “*We had fun as well as learning,*

and learning was fun.” Thus, entertainment sub-theme was associated with both interaction and impact on learning themes. Similarly, active participation sub-theme was correlated with the two above-mentioned themes. The following statement by Q-Nilay confirmed this correlation: *“Professor, we already sit on the desks without moving for forty minutes, we listen to the teacher, so at least it is fun learning with this method.”*

The problems that pre-service teachers experienced during the implementation of Quizizz were categorized in two sub-themes. The first one was the sub theme of infrastructural problems. On the issue, Q-Azim stated the following: *“An application that does not require the Internet could be developed, for example, or always it is always a problem.”* Participants emphasized Internet and application related problems as follows: Q-Nilay: *“For instance, we both answer the same question within five seconds, but his Internet speed is better than me and at the end, he is considered to have answered the question quicker than me.”* Q-Ozan: *“If everyone had the same Internet speed, then the old phones could have slowed it down.”* Within the context of this sub-theme, it was determined that infrastructural problems negatively affected participation, hence the interaction as observed in the following statement by Q-Nilay: *“When the Internet slows down, you would stop doing the quiz on the third question thinking that others have already answered and I cannot keep up with them.”* Based on this statement, it can be suggested that the sub-theme of the infrastructure problems was correlated with the interaction theme. Pre-service teachers stated the following on the problems they experienced due to the Quizizz application. Q-Nilay: *“I answer the question correctly as well, but when someone answers the question a second earlier, he becomes the leader.”* Q-Yunus: *“That is how I could not become the leader twice, it is a problem that there is only one leader.”* The following statement by Q-Yunus on this sub-theme was remarkable: *“The projected images should be different, when the same image appears every time, it becomes difficult to concentrate.”* Based on this statement, it can be suggested that pre-service teachers expected diversification of the feedbacks in Quizizz application.

In both focus group interviews, it was observed that they expressed mostly positive views on the sub-themes of reinforcement, motivation, competition, entertainment, active participation and considered Kahoot and Quizizz applications similar at this level. Although internet infrastructure problems were common in both applications, it was determined that Kahoot was more limited when compared to Quizizz due to problems such as the requirement for other equipment and distractions it caused. Furthermore, the visual feedback mechanism in Quizizz application was limited since it is individual-based, leading to technological problems at the individual level.

However, all pre-service teachers in both groups replied “Yes” to the question “Would you like to participate in another Kahoot/Quizizz application? Why?” The following dialogue between Q-Azim and Q-Yunus was among the most significant replies to the question “Why?”

“Q-Azim: It will not work in every course, for instance, it would be better in verbal courses, in certain courses such as literature, like you will find the elements of a sentence, etc.

Q-Yunus: In other words, the Quizizz of that course would be boring as well.”

The dialogue above demonstrated that pre-service teachers preferred the gamified quiz applications for the content where theoretical but short questions could be asked. Thus, it can be suggested that the fact that pre-service teachers expressed positive views in focus group interviews, but there was no statistically significant effect could be due to the SRM course content.

4. Conclusion and discussion

The present study aimed to investigate the reflections of gamification activities (Kahoot and Quizizz) used as formative assessment tools for academic achievement and student engagement on learning environments. It was also aimed to investigate whether the use of one gamification application led to differences in academic achievement and student engagement. In the study where two experiment groups and one control group were assigned, formative assessments were conducted at the beginning and end of each class using Quiz with one experiment group and with Kahoot with the other experiment group in the engagement and evaluation steps of the 7E teaching model. In the control group, formative assessment was conducted with conventional questions and answers. The quantitative study findings suggested that gamification affected academic achievement and student engagement in the scientific research methods course. However, inability to determine the direction of this impact by post-hoc tests indicated the possibility of an effect due to inter-measurement interaction. Thus, the graphs produced by MANOVA were examined. In the graphs, it was observed that the impact of Kahoot-based instructional activities on academic achievement and student engagement was higher when compared to that of the control group. On the other hand, the educational activities that were conducted with Quizizz were less effective when compared to the control group. Limited visual feedback capacity of the Quizizz application, the fact that the questions progressed at an individual pace and the individual technological problems experienced by the participants may have prevented academic achievement and student engagement as demonstrated by the qualitative findings.

Literature review demonstrated that certain studies reported that the gamification used for assessment purposes improved achievement and engagement (Biçen & Kocakoyun, 2018; Bolat, Şimşek, & Ülker, 2017; Bury, 2017; Fotaris, Mastoras, Leinfellner, & Rosunally, 2016; Tsahouridis, Vavougiou & Ioannidis, 2018; Turan & Meral, 2018). Bury (2017), in a study that examined whether online assessment tools (Kahoot and Quizizz) increased student motivation, participation and learning, concluded that online assessment tools developed students' grammar knowledge and the students desired to specialize in the content of online tools. Furthermore, it was determined that the reason students desired to use Kahoot and Quizizz applications in the classroom was due to students' need for strong stimuli or the will to receive immediate feedback on how well they performed on the test. Bolat et al. (2017) investigated the impact of using Kahoot application as a formative assessment tool on the academic achievements of pre-service teachers and reported that Kahoot application had an effect on students' retention levels based on the revised Bloom taxonomy,

however it did not have an effect on application levels. [Turan and Meral \(2018\)](#) investigated the effects of game-based and non-game-based online student response systems on student achievement, engagement, and exam anxiety levels in a study where Kahoot was used in the experimental group and Socrative online student response system was used in the control group for four weeks. The study results demonstrated that the game-based student response systems increased achievement and participation, and decreased the test anxiety levels of the students. He proposed the use of online game-based student response systems in different topics in social studies courses. In an experimental study conducted in Basic Software Development course, [Fotaris et al. \(2016\)](#) aimed to determine the impact of gamification applications (Kahoot, Who wants to be a Millionaire, and Code academy) used as formative and summarizing assessment tools on students. The data collected with observations, survey forms, interviews and documents demonstrated that the above-mentioned applications had a positive effect on students' motivation, retention and performance. Furthermore, the study findings demonstrated that Kahoot and who wants to be a millionaire gamification applications allowed the immediate implementation of knowledge, reinforcing learning outcomes, and students felt good about receiving immediate feedback about their achievements, which in turn improved their self-esteem has been revealed in the study.

The qualitative study findings revealed a structure that included three main themes and seven sub-themes. The sub-themes indicating the impact of gamification on learning and interaction and the sub-themes on the presence of application-related problems are presented in the findings section with direct quotes. The interviews conducted with Kahoot and Quizizz application groups demonstrated that the quizzes conducted at the beginning and at the end of each class reinforced the topical knowledge of the students and the students came to class prepared since they knew about the pre-class quizzes, which in turn motivated the students for the course. Furthermore, in the interviews conducted with the Quizizz group, it was determined that the students followed the instructions more carefully due to the post-instruction quiz. It could be suggested that feedbacks provided via gamification reached their main purpose. When considering quantitative findings, it can be said that these positive views on motivation confirmed engagement and academic achievement difference between groups, as said in [Pekrun and Linnenbrink-Garcia's \(2012\)](#) study. In the sub-themes of entertainment and competition, it was found that the students had fun with the emojis provided as feedback, their curiosity about the achievements of their friends were satisfied, they were ambitious about being the class leader in scores, and they considered this competitive environment as fun. In the sub-themes of infrastructure problems and application-related problems, it was determined that the students experienced Internet speed problems and since they experienced problems in connecting the school networks, this led to competition problems. Furthermore, it was determined that high hardware requirements of Kahoot application, presentation of the questions and answer options on different screens were distracting for the learners in the study. It was also identified in the study that the feedback emojis of the Quizizz application were inadequate. Previous study findings were consistent with the above-mentioned findings ([Biçen & Kocakoyun, 2018](#); [Cahyani, 2016](#); [Licorish et al., 2018](#); [Medina & Hurtado, 2017](#); [Yapıcı & Karakoyun, 2017](#)). In a study that aimed to determine student views on gamification-based interactive response systems, [Solmaz and Çetin \(2017\)](#) utilized and compared three gamification applications (Kahoot, Socrative, Plickers) in the IT course. In the study, it was determined that students preferred Plickers, Kahoot, and Socrative applications, respectively. It was found in the study that Kahoot led to the most competitive environment and was the easiest to use, and the students liked the feedback form of the Plickers application the most and had the most fun with this application. They liked the fact that Kahoot was colorful, while the presentation of the questions was the most unpopular aspect of the application. While the most popular aspect of Socrative was its feedbacks, the most unpopular aspect was the scoring system. Students liked the QR code system in Plickers, however the risk of misrepresenting the card was not appreciated. [Cahyani \(2016\)](#) reported that students were happy when they conducted gamified learning activities. Furthermore, the study revealed that gamified learning activities challenged the students, and the students desired to master in all activities and pass all levels. In a study that aimed to determine student views on Kahoot application, [Biçen and Kocakoyun \(2018\)](#) determined that gamification increased the interest of the students in the course and encouraged them to be more ambitious for achievement. Furthermore, the study findings demonstrated that the reward system increased student motivation in the course, the students feel important when they win badges, and the competitive environment shortens the student response time. [Licorish et al. \(2018\)](#) reported that Kahoot contributed to teacher-student interaction, however it sometimes led to negative emotions due to the extreme competitive environment. They argued that applications such as Kahoot were necessary in long courses. They also demonstrated that students' desire to perform well in Kahoot also increased their interest in the course and interactions with each other. [Glover \(2013\)](#) reported that gamification helps students to overcome their negative attitudes in a competitive environment and encourages them for more productive behavior.

The present study aimed to determine the positive reflections of the assessments conducted with gamification instead of conventional assessment on the students. Due to the positive effects of technology on the field of measurement and evaluation, it was emphasized in International Education Technology Standards that teachers should conduct numerous and various formative-grading assessments using the technologies in evaluation activities, especially in active learning activities. The determination of the effectiveness of gamification in summarizing and diagnostic measurement and evaluation types is a requirement for the literature.

Declaration of interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.compedu.2019.02.015>.

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